Knight: Chapter 15

Fluids & Elasticity

(Fluids & Pressure)

Fluids…

- are substances that *flow*. fluids flow
- take the shape of their container.
- include *both* gases & liquids.

Gas..

- is *compressible*. Gas compressible
- a system in which each molecule moves through space as a free, non-interacting particle until it collides with

- *another molecule.*
- the *walls of the container.*

Liquid..

- is *incompressible.* Incompressible

Volume and density

Mass density…

$$\rho \equiv \frac{m}{V}$$

”

$1\ \frac{kg}{m^3} \times \frac{1000\ g}{1\ kg} = \frac{1000\ g}{m^3}$

$\frac{1000\ g}{m^3}\left(\frac{m}{100\ cm}\right)^3 = 1.0\times10^{-3}\ \frac{g}{cm^3}$

What are the SI units?

$$[\rho] = \frac{[m]}{[V]} = \frac{\mathrm{kg}}{\mathrm{m}^3}$$

Exercise for student: convert to $\mathrm{g/cm}^3$

Some Densities…

Material	Density (kg/m3)

Water	1000
Air	1.28
Ice	917
Lead	11,350
Gold	19,320
Sand	2800
You	??

i.e.

Calculate the mass of the air in this room?

$$\rho = \frac{m}{V}$$

$$m = \rho V$$

$\rho = 1.28\ kg/m^3$

$V = L \times W \times H$

$= 9m \times 7m \times 3m$

$V = 189\ m^3$

$m = 1.28\ kg/m^3 \times 189\ m^3$

$m = 210\ kg$

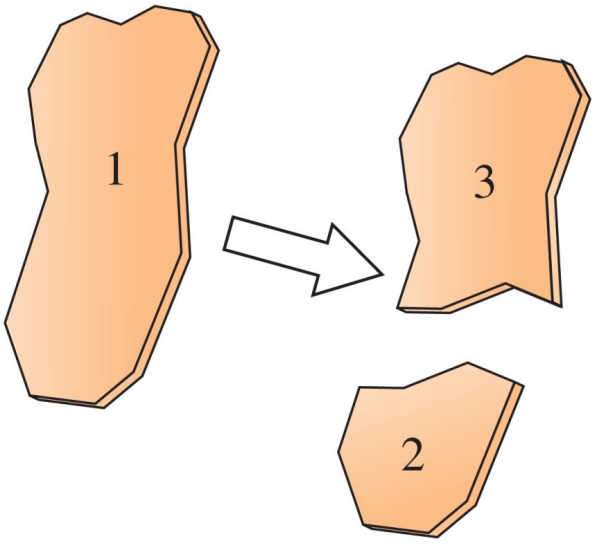
Quiz Question 1

A piece of glass is broken into two pieces of different size.

How do their densities compare?

1. $1 > 3 > 2.$
2. $1 = 3 = 2.$
3. $1 < 3 < 2.$

$\rho = \frac{m}{V}$



Pressure

Pressure, p, is the magnitude of the force exerted *perpendicular* to a given surface

$$p \equiv \frac{F}{A}$$

- What are the SI units?

$Pa = \frac{N}{m^2}$ $P = \frac{F}{A}$

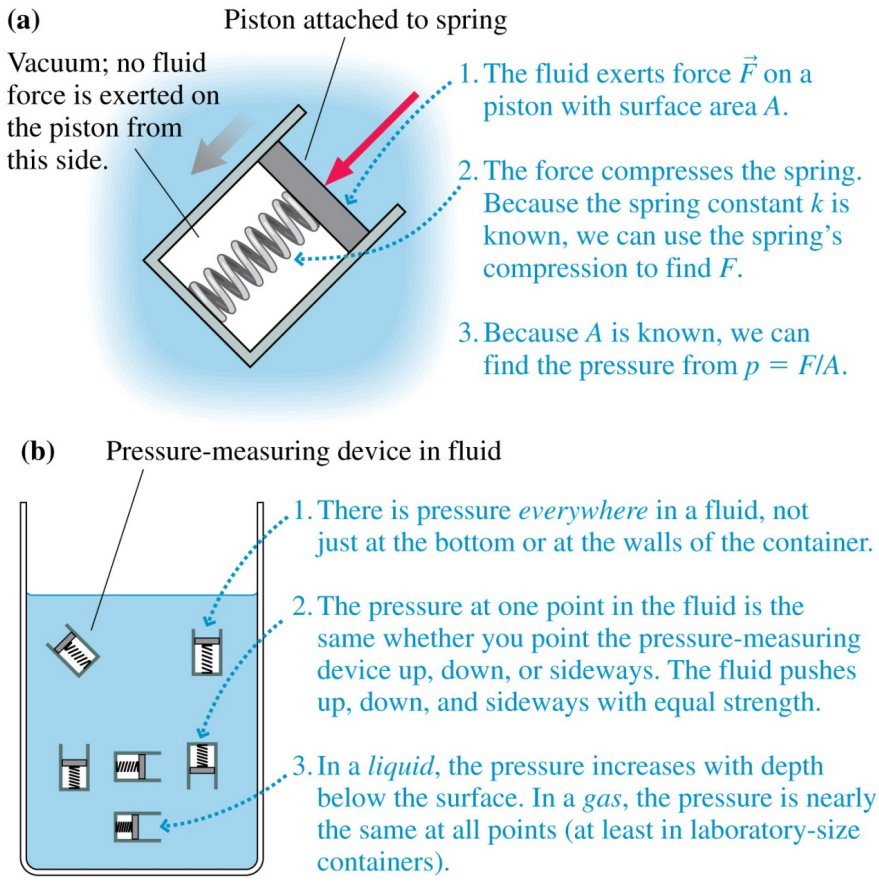
$$[p] = \frac{[F]}{\quad} = \frac{N}{\quad} = \text{Pa}$$

$$[P] \quad [A] \quad m^2$$

- *Other units:*

$$1 \text{ atm} = 1.01 \times 10^5 \text{ Pa} = 760\ mm\ Hg = 14.7 \text{ PSI}$$

Way to measure pressure?



Pressure

Two contributions to the pressure in a container of fluid:

1. *gravitational*

Slightly less density and pressure at the top

- due to gravity pulling down on the liquid or gas.

2. *thermal*

- due to the collisions of freely moving gas molecules within the walls, which depends on gas temperature.